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U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF VEGETABLE PHYSIOLOGY AND PATHOLOGY.

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SOME



EDIBLE AND POISONOUS FUNGI.

BY

DR. W. G. FARLOW,

Professor of Cryptogamic Botany, Harvard University.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF VEGETABLE PHYSIOLOGY AND PATHOLOGY,
Washington, D. C., April 6, 1898.

SIR: I have the honor to transmit herewith an article on Some Edible and Poisonous Fungi, by Dr. W. G. Farlow, of Harvard University, and respectfully recommend that it be published as Bulletin No. 15 of this Division. This article has already been published in the Yearbook of the Department for 1897, but the demand for literature relative to mushrooms is so great that it is desirable to have the article in the form of a bulletin.

Respectfully,

ALBERT F. WOODS,
Acting Chief of Division.

Hon. JAMES WILSON,
Secretary of Agriculture.

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SOME EDIBLE AND POISONOUS FUNGI.

By Dr. W. G. FARLOW,

Professor of Cryptogamic Botany, Harvard University.

INTRODUCTION.

In the present paper an attempt is made to present, in as simple a manner as the subject permits, the characteristics of a few of our most common fungi, together with notes on poisonous species which might be mistaken for the edible by those who have not studied fungi. It may be called a first lesson in distinguishing edible and poisonous fungi, and is not intended as a guide to those who are to a certain extent already familiar with the subject, but merely as a primer for those who do not recognize even our commonest species, but who desire to enroll themselves among the increasing ranks of fungus eaters, or, to use a rather high-sounding word, mycophagists.

The question which everyone asks first is, How can you tell a mushroom from a toadstool? This is one of the questions which no one can answer, unless an explanation of why the question should never be asked may be considered an answer. You can not tell a mushroom from a toadstool because mushrooms are toadstools. The reason why the question is so frequently asked is because the belief is well-nigh universal in this country that the fleshy umbrella-shaped fungi are divided into two classes—mushrooms, which are edible, and toadstools, which are poisonous. This assumed difference does not in fact exist. All the fleshy umbrella-shaped fungi are toadstools, and to a small number of the best-known edible forms the name mushroom is applied popularly and in commerce; but not a small number of the other toadstools are edible, and a great many of them, probably the most of them, are not poisonous.

The question that people really wish to have answered is not how can you tell a mushroom from a toadstool, but how can you tell an edible fungus from a poisonous fungus. Our knowledge on this point is empirical. We know that certain species are edible and others are poisonous, because people have eaten the former and found them to be good, while the latter have produced unpleasant symptoms and even death. But the number of species which have been eaten or experimented with is small compared with the whole number of species of toadstools, and with regard to the species which have not been tried experimentally or accidentally we can only say that they are probably edible or poisonous, judging by their resemblance to other species known to be such. Although, in the absence of experience, analogy is the only guide, it is not a sure guide, and unpleasant surprises may arise.

HOW TOADSTOOLS (INCLUDING MUSHROOMS) GROW.

In the case of persons for whom this paper is written, it is unnecessary to consider the question of how far we are justified in judging from analogy alone, since the main point is to learn to recognize a certain number of the most common edible species and to distinguish them from poisonous species which resemble them. The toadstools and mushrooms all belong to the group of fungi known as Hymenomyces; and before proceeding to speak of the different species which we are to consider, it will be well to state briefly some points common to the whole group.

The toadstools, including mushrooms, first appear on the surface of the ground, on the bark of trees, or on other substances in the form of small, solid balls, which gradually enlarge and at length shoot up into a stem, or stipe, bearing at its summit the umbrella top, or pileus, which is at first closed around the stalk like a closed umbrella and then expands more or less widely according to the species. When small and just beginning to open, the growths are called buttons, as in the so-called button mushrooms usually imported in cans from France. The young buttons arise from a complicated mass of fine, colorless threads in the ground, in logs, dung, or other substances. The mass of threads is known to cultivators of mushrooms as the spawn and to botanists as the mycelium, each individual thread being called a hypha.

It is often said that toadstools grow in a night, but such is not the case. After the button has fully formed it may develop into the mature toadstool very rapidly, but the development of the button from the spawn takes usually considerable time, and weeks, months, or even years may elapse before the spawn comes to the surface and forms the young button. If we compare the functions of the spawn in the ground and of the toadstool above ground with those of the roots, trunk, branches, leaves, and fruit of a plant like an apple tree, we find that in the toadstool the spawn itself performs all the functions of the root, branches, and leaves of the apple tree, and that the toadstools are really only the fruiting part of the fungus, corresponding to the apples themselves. If we imagine an apple tree to have its trunk, branches, and leaves buried in the ground, leaving only the apples themselves standing above the ground, and then to have the buried parts changed into a mass of fine threads, we shall have something similar to what is found in the case of a toadstool; in other words, all the absorption and assimilation of food, all the purely vegetative functions, are performed by the spawn, while the toadstool, like the apple, is only a reproductive body—the apple containing seeds, the toadstool spores (microscopic dust-like bodies, which correspond in function to seeds).

CHARACTERISTIC MODIFICATIONS OF FUNGI.

Without stopping to consider the various modifications of the spawn, we can pass at once to the different modifications of the stalk and of the pileus borne at its summit. In the Hymenomycetes, or toadstool family, the underside of the pileus is the part that bears the spores, which correspond to the seeds of other plants. In some cases the under surface consists of a series of gills resembling knife blades, which radiate from the top of the stalk to the circumference, like the spokes of a wheel; in others it consists of a mass of small pores or tubes packed closely together, side by side; in others, of teeth, while in still others the surface is only slightly wrinkled or undulated. The gill-bearing group are called by botanists Agaricini, which we may speak of briefly as Agarics; the tube-bearing group are called Polyporei, the teeth-bearing group Hydnei, and those with a merely wrinkled surface are called Thelephorei. In all these groups there are some species in which the stalk is wanting, and then of necessity the fructifying surface does not face downward, but upward, lying flat on the substratum. For our present purpose the stalkless forms need not be considered, as with very few exceptions they are not edible species. There is still another group, the coral-shaped fungi, belonging to the Hymenomycetes, although they do not resemble the toadstools or mushrooms in shape, which will be referred to later. By far the greater number of our edible and poisonous species belong to the two groups of gill-bearing and tube-bearing fungi, and therefore we need consider the members of the other groups only very briefly.

EDIBLE GILL-BEARING FUNGI AND RULES FOR THEIR DETERMINATION.

Let us pass at once to the principal edible fungi belonging to the gill-bearing group. This group is a very large one, and includes thousands of species, from which we must select a small number of the best known and most common. Those who wish to collect fungi for their own consumption or for the market must begin by committing to memory the distinguishing marks of a few species, and until this has been done they should not venture to trust to general rules for distinguishing good species from bad. The quickest way to accomplish the object, of course, is by having some person who is an expert give practical lessons in the field; but in most cases this is not possible, not to mention the fact that some who think they are expert are not. Dull and dry as it may be, one must memorize certain points until familiar with a few common species. There is one rule, however, which should be applied in the beginning by everyone, viz, no one unless decidedly expert should collect for eating the buttons, or small, unexpanded fungi, since in their young condition it is often impossible, even for experts, to recognize what the species is. The imported canned buttons are safe enough, because they are the young of the

cultivated mushroom, and are put up by persons who know their business. Another equally general and self-evident rule is, not to collect or eat fungi which have begun to decay or are not otherwise in good condition.

THE COMMON MUSHROOM.

Assuming, then, that these two rules are never to be neglected, let us pass to a description of the fungus known as the common mushroom, the *Agaricus campestris* of botanists. This is practically the only species cultivated in this country, and is the only fresh species sold in the Northern markets in the winter months. It grows wild during the summer months, being most abundant in August and September, and inhabits grassy fields, especially those where animals have been at pasture. It is especially abundant in fields near the seashore, and is much less common in the mountains. It is almost never found in woods, and is not plentiful anywhere except in grassy pastures. Pl. XXI represents the mushroom in its normal condition. The color of the stalk and pileus varies from whitish to a shade of drab, but the color of the gills, a point which must never be overlooked, is at first pinkish and then a brownish purple. This color is due to the spores, which are borne on the gills, and if the pileus is cut off from the stalk and placed on a piece of white paper the spores fall on the paper and in a few hours leave on it a colored impression of the gills. The stalk is cylindrical and solid, and has, rather more than halfway up, a membranous collar called the ring; but there is no membrane or scales found at the base of the stalk, which appears to come directly out of the ground. Mushrooms are sometimes single, but frequently there are several, though not many, in a cluster, some mature, others younger. If we examine a specimen before it is fully expanded, we shall not be able to see the gills, since there is a thin membrane, called the veil, which extends from the stalk to the margin of the pileus. When the veil is ruptured, exposing the gills behind, a part remains attached to the stalk, forming the ring already referred to, and generally some fragments remain attached to the margin of the pileus. In older specimens the ring shrinks, but generally a mark remains, showing where it was attached.

Since nearly all persons begin their attempts at fungus hunting by going in search of the common mushroom, it is of the greatest importance that they should bear clearly in mind the characteristic marks by which that species is distinguished. The general appearance is sufficiently shown on Pl. XXI.

Summed up briefly, the first thing to be noticed is whether the gills are a purple brown, as they should be when mature. Most of the fatal errors have arisen from not noticing this point and selecting species where the gills were white. The next point is to notice whether the stem is cylindrical and solid and has a ring or traces of a ring above, and especially



COMMON FIELD MUSHROOM (*AGARICUS CAMPESTRIS*), EDIBLE.



FLY AGARIC (*AMANITA MUSCARIA*), POISONOUS.

whether it seems to come directly from the ground, or whether the base is bulbous and sheathed with a membranous bag or scales. If it has a sheath or scales it can not be the common mushroom. Furthermore, it must not be forgotten that the mushroom never grows on trees or fallen trunks, but in open, grassy pastures. If a collector finds a fungus having the points here mentioned, the chance of his being injured by eating it is next to nothing, for there is only one species at all answering the description which is to be avoided, and that is very rare indeed, and has a taste so disagreeable that no one would wish to eat it, while the taste of the mushroom is pleasant.

POISONOUS SPECIES RESEMBLING THE COMMON MUSHROOM.

Inasmuch as most cases of poisoning are due to mistaking some injurious species for the common mushroom, it will be best before passing to the other edible species related to the mushroom to refer to two of the most common poisonous forms which have been eaten by mistake for the *Agaricus campestris*, viz, *Amanita phalloides*, the deadly agaric, and *Amanita muscaria*, the fly agaric. Of the two, the former is the more dangerous and the latter the more common.

THE FLY AGARIC.

The fly agaric (*Amanita muscaria*, Pl. XXII), so called because decoctions of it are used for killing flies, is in most places, at least in the northern and eastern parts of the country, a common species—often a good deal more abundant than the common mushroom. It is found during the summer along roadsides, on the borders of fields, and especially in groves of coniferous trees. It prefers a poor soil, of gravelly or sandy character, and occurs only exceptionally in the grassy pastures preferred by the common mushroom. It grows singly and not in groups, and attains a large size, being one of the most striking toadstools. It differs from the common mushroom in having gills which are always white, never pink or purple, and in having a hollow stem which is bulbous at the base and clothed with irregular, fringy scales on all the lower part. The pileus varies in color from a brilliant yellow to orange and a deep red, the yellow and orange being more frequent than the red. The surface is polished and has scattered over it a larger or smaller number of prominent, angular, warty scales, which can be easily scraped off. The gills and stalk are white, and there is a large, membranous collar, which hangs down from the upper part of the stem. The general appearance shown on Pl. XXII, together with the color of the pileus and gills noted above, are such that it is difficult to conceive how anyone who has ever seen a common mushroom or read a description of one could mistake the fly agaric for the mushroom. Nevertheless, in the writer's experience, no fungus is so often collected by mistake on the supposition that it

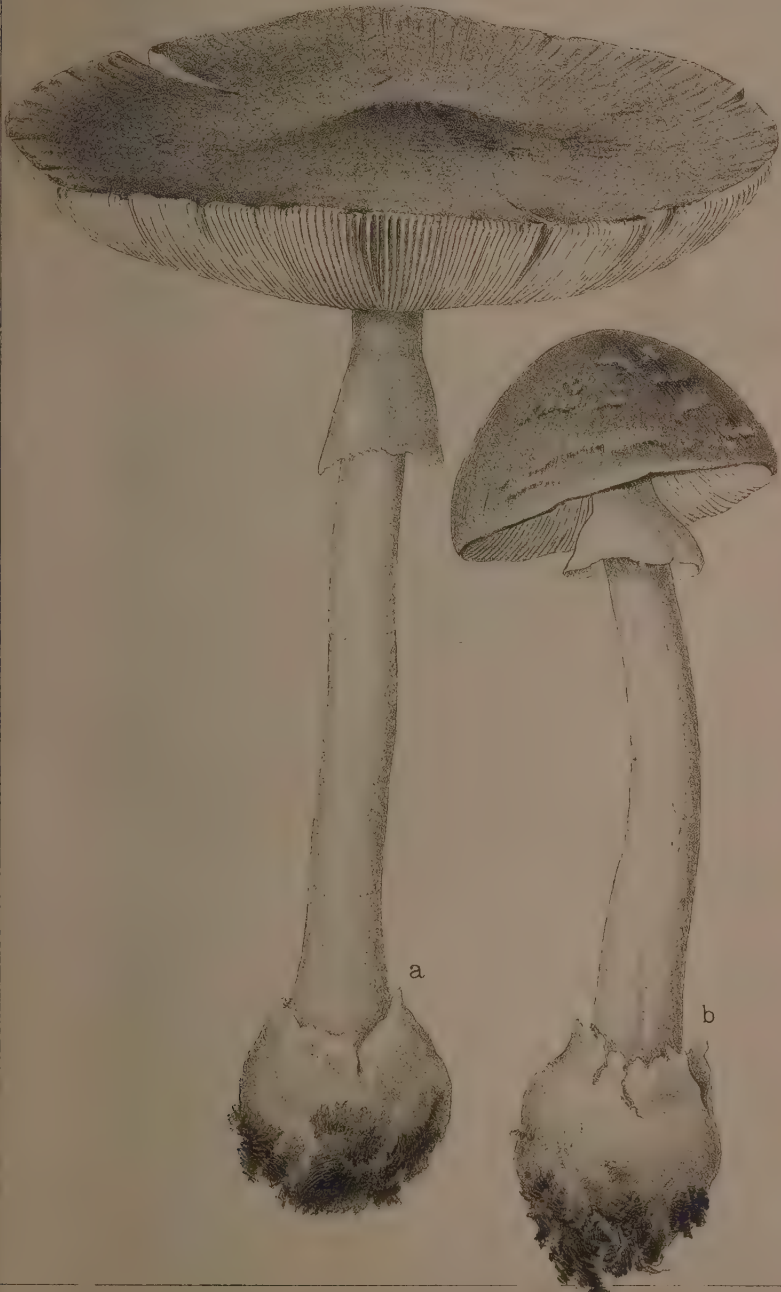
is the common mushroom, and it is to the fly agaric that recent cases of poisoning in Washington, D. C., were due.

When the fly agaric is young the unexpanded pileus is convex, almost globose, and densely covered with large, more or less concentric warts, which, as the pileus expands and becomes flat topped, separate from one another. When old, and especially late in the season, the pileus loses its brilliant color and is then a pale yellow or even a dirty white; but even in this case the absence of the brownish-purple gills and the different stalk make it easy to distinguish it from the common mushroom.

The fly agaric bears a much closer resemblance, and in its paler condition a decided resemblance, to one of the best of our edible fungi, *Amanita rubescens*, so called because the flesh generally has a reddish tinge; but that species is not to be recommended to the novice, since it is sometimes difficult to recognize. The writer has no desire to indulge in this really delicious fungus, unless it be collected by someone of whose expert knowledge he is quite sure. It is possible that Count de Vecchi, who recently died from eating the fly agaric, although he was believed to have some knowledge of the different kinds of fungi, may have mistaken the fly agaric, gathered late in the season, when it is generally paler than in midsummer, for *Amanita rubescens*. It is, however, possible that he mistook the fly agaric for the royal agaric (*Amanita caesarea*), one of the most highly prized edible species, which is not common in the Northern States, but is more common in the Southern. It resembles the fly agaric in the color of the pileus, but is distinguished from it in not generally having the wart-like scales found on the fly agaric, and especially in having the gills, ring, and stalk yellow instead of white, and in having no flocculent scales around the stalk, but instead a bag-like membrane, through which the stalk protrudes. With these marked differences, there seems to be no good reason why the fly agaric should be mistaken for the royal agaric.

THE DEADLY AGARIC.

The second poisonous species, which has been mistaken for the common mushroom, and which has been more frequently the cause of death than any other, is *Amanita phalloides*, well named the deadly agaric (Pl. XXIII). It is rather common and grows singly in woods and on the borders of fields, rarely appearing in lawns, and is not pre-eminently an inhabitant of grassy pastures, like the mushroom. It prefers a damper and less sandy soil than that chosen by the fly agaric. The pileus is often a shining white, but may be of any shade, from a pale dull yellow to olive, and when wet is more slimy than the mushroom or the fly agaric. It has no distinct scales and only occasionally a few membranous patches on the pileus. The gills and stalk are white, and the latter has a large ring like the fly agaric,



DEADLY AGARIC (*AMANITA PHALLOIDES*), POISONOUS.

and is hollow, or, when young, is loosely filled with cottony threads, which soon disappear. The base of the stalk differs from that of the fly agaric in being more bulbous and in having the upper part of the bulb bordered by a sac-like membrane, called the volva. The volva is often of considerable size, but more frequently it is reduced to a membranous rim, as shown on Pl. XXIII. In this species the stalk is longer and slenderer in proportion to the diameter of the pileus than in either the fly agaric or the common mushroom, and is buried rather deep in the soil or dead leaves, so that it often happens that the bulb is broken off and left behind when the fungus is gathered.

DIFFERENCES BETWEEN THE COMMON MUSHROOM AND THE FLY AND DEADLY AGARICS.

The differences between the common edible mushroom and the fly agaric and deadly agaric, which the reader can easily remember, are as follows:

(1) The common mushroom has a pileus which is not covered with wart-like scales; gills which are brownish purple when mature; a nearly cylindrical stalk, which is not hollow, with a ring near the middle, and without a bulbous base sheathed by a membrane or by scales.

(2) The fly agaric has a pileus marked with prominent warts; gills always white; a stalk, with a large ring around the upper part, and hollow or cottony inside, but solid at the base, where it is bulbous and scaly.

(3) The deadly agaric has a pileus without distinct warts; gills which are always white, and a hollow stalk, with a large ring, and a prominent bulb at the base, whose upper margin is membranous or bag-like.

(4) Other minor points of difference are the different places in which these species grow, and also the colors, which, although they vary in each case, are brilliant yellow or red in the fly agaric, white varying to pale olive in the deadly agaric, and white usually tinged with a little brown in the mushroom.

(5) A word should be said as to the size and proportions of the pileus and stalk in these three species. In the mushroom the pileus averages from 3 to 4 inches in breadth, and the stalk is generally shorter than the breadth of the pileus and comparatively stout. The pileus remains convex for a long time, and does not become quite flat-topped until old. The substance is firm and solid. In the fly agaric the pileus, at first oval and convex, soon becomes flat and attains a breadth of 6 to 8 inches and sometimes more. The stalk has a length equal to or slightly exceeding the breadth of the pileus, and is comparatively slenderer than in the common mushroom, but nevertheless rather stout. The substance is less firm than in the common mushroom.

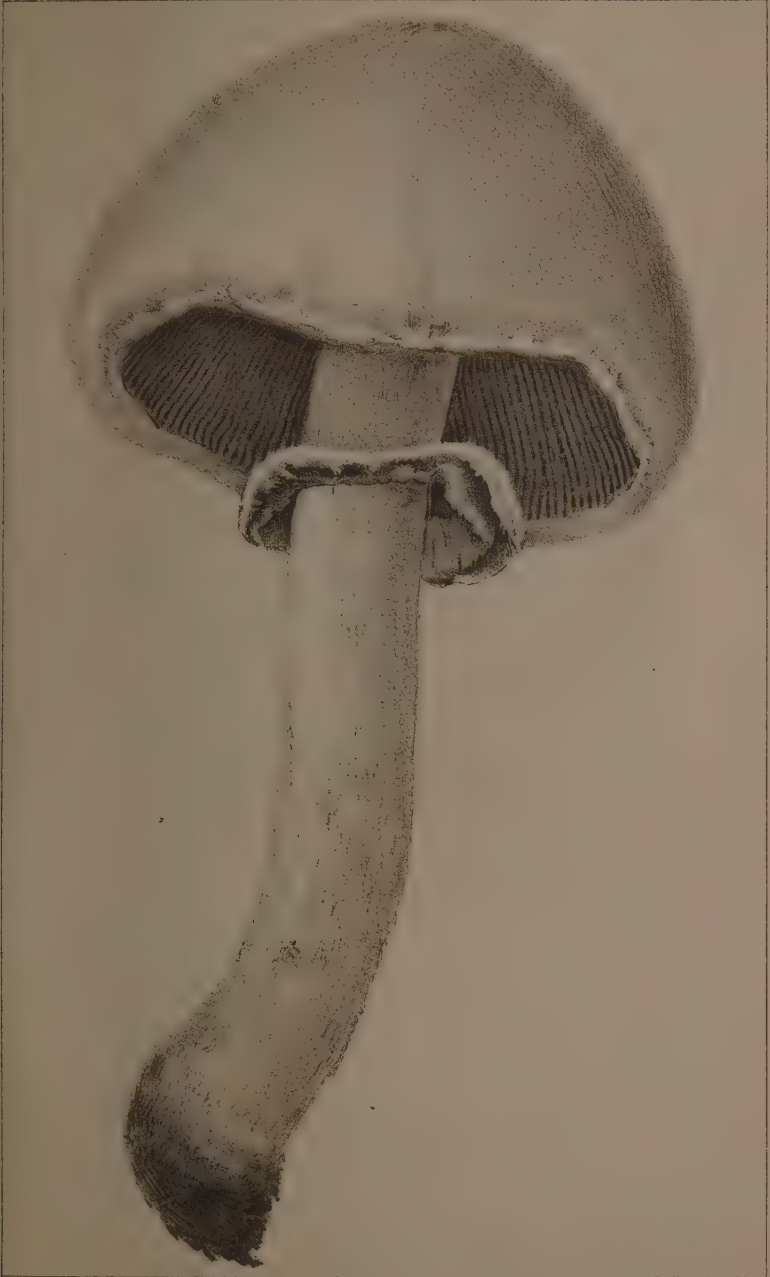
(6) The pileus of the deadly agaric is thinner than that of the common mushroom, and, from being rather bell-shaped when young, becomes gradually flat-topped with the center a little raised. In breadth it is intermediate between the two preceding species. The stalk usually is longer than the breadth of the pileus, and the habit is slenderer than in the two preceding species. All three species are pleasant to the taste, which shows that one can not infer that a species is not poisonous because the taste is agreeable. The fly agaric has scarcely any odor. The other two species have certain odors of their own, but they can not be described.

VARIETIES OF THE COMMON MUSHROOM AND CLOSELY RELATED EDIBLE SPECIES.

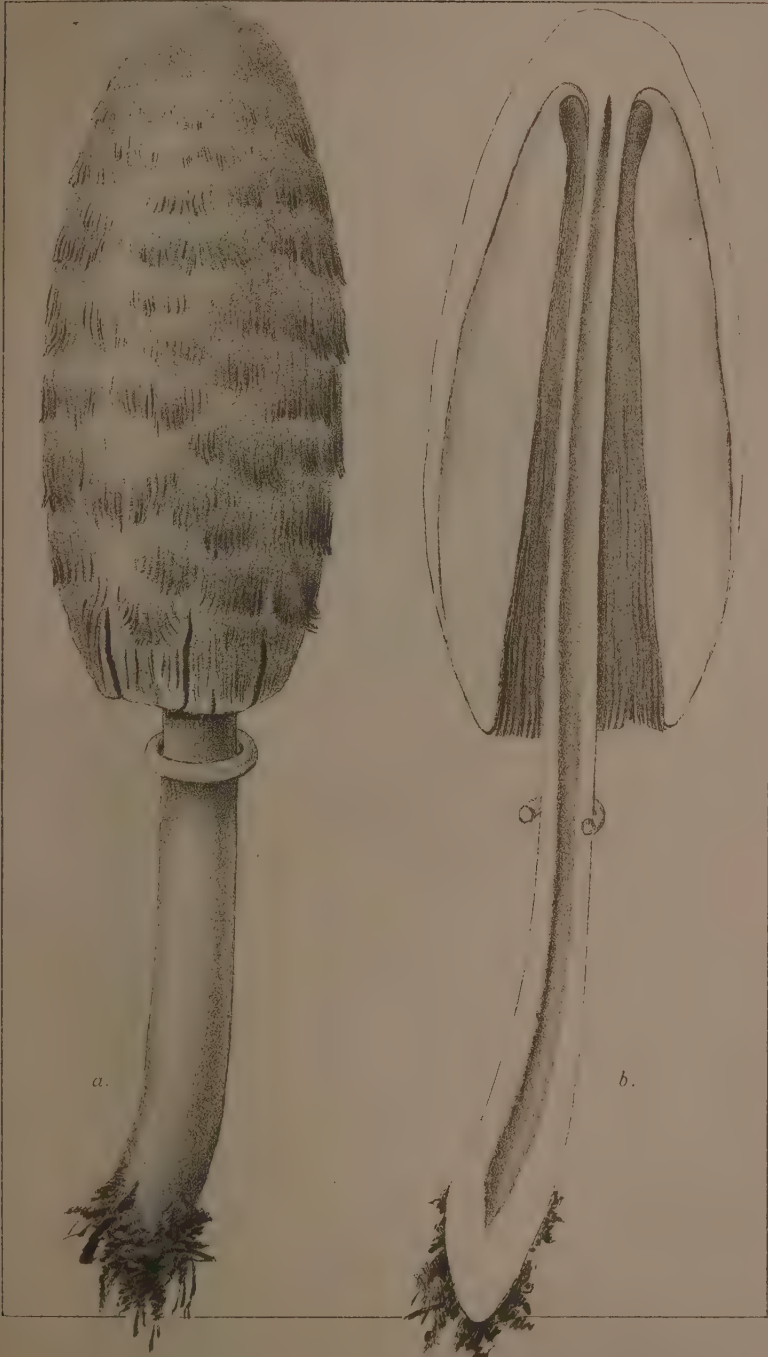
Having learned in detail the distinctions between the common mushroom and the two poisonous species most frequently mistaken for it, some of the varieties of the common mushroom and a few edible species closely related to it will now be considered. The pileus of the mushroom has been described as smooth and without scales. Varieties are not infrequently found in which the surface is more or less flocculent and with flat, tufted scales. The scales, however, are not prominent, and are not at all like the large, angular warts on the fly agaric, which can be easily scraped off the otherwise smooth surface, whereas the scales of common mushrooms are formed by the breaking up of the surface into a sort of fringe, which can not be pulled off without tearing the pileus. There is also an excellent variety of the mushroom, which may perhaps better be called a closely related species, which has an agreeable flavor of almonds. It should not be understood, however, that this is the only fungus which has a flavor of almonds, but it is the only one with this flavor that is closely related to the common mushroom.

THE HORSE MUSHROOM.

The horse mushroom (*Agaricus arvensis*) looks very much like the common mushroom, but is considerably larger, being sometimes 8 or 10 inches broad, or even broader. It frequently passes for the ordinary mushroom, and, in fact, most of the large specimens sold as the ordinary mushroom are in reality *Agaricus arvensis*. It grows frequently in hedges and in cultivated places, and differs from the mushroom in having the pileus generally a more shining white, in having the stem a little hollow as it matures, in the fact that the gills are at first white and do not change to a brownish purple until comparatively late, and especially in having a ring which is composed of two adherent layers, the inner being a smooth membrane and the outer shorter and cut up in a stellate manner. On Pl. XXIV, representing the horse mushroom, the peculiarity of the ring is shown.



HORSE MUSHROOM (*AGARICUS ARVENSIS*), EDIBLE.



HORSE-TAIL FUNGUS (*COPRINUS COMATUS*), EDIBLE: *a*, ENTIRE PLANT; *b*, SECTION.

HYPHOLOMA APPENDICULATUM.

Another fungus should be mentioned in this connection, *Hypholoma appendiculatum*, since it is very common and edible, although not so good as either of the two species just described. It abounds during all the summer months in grassy places, growing on or near the remains of old stumps, and is found in dense clusters. The pileus is quite thin and conical or bell-shaped, and the edges soon split radially and roll upward. The very narrow gills are purple brown, and the stalk, which has no ring, is very slender and tubular. The color is a translucent white, often with a purple tinge, as the gills show through the thin pileus, but when young and wet it may have a tinge of yellow or brown. Although small and watery, the pileus being hardly 2 inches broad and the stalk not more than 2 or 3 inches long and not much over a quarter of an inch broad, it is often so abundant that enough for a meal can easily be collected in a short time.

THE HORSETAIL FUNGUS.

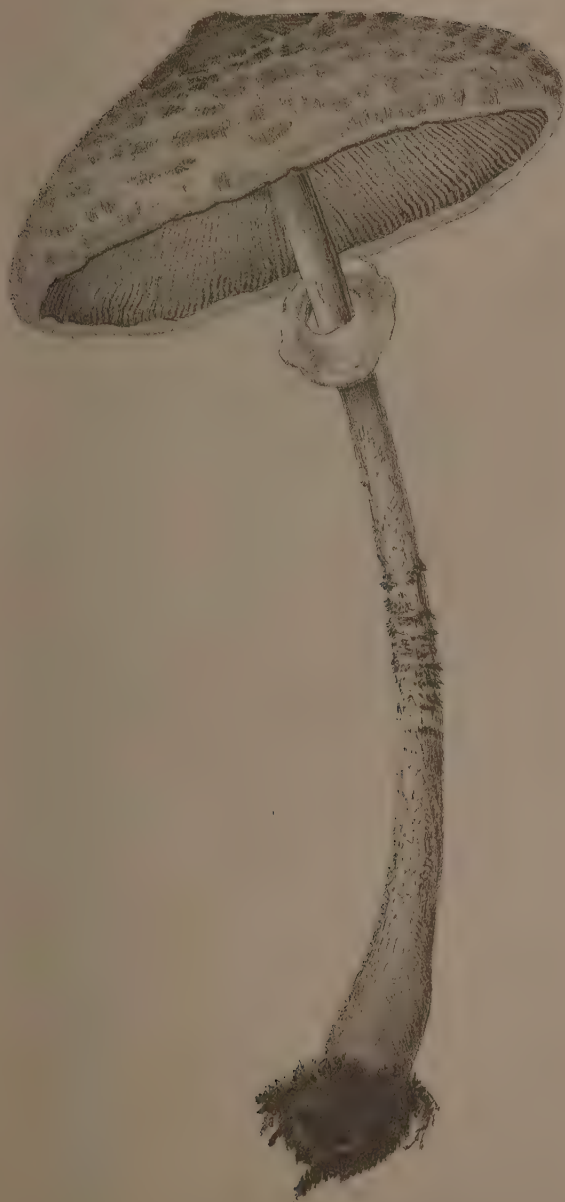
With the exception of the royal agaric and *Amanita rubescens*, noted only in passing, the edible species so far mentioned belong to that division of the Agaricini, or toadstool family, which has brownish-purple spores and gills. To another division, in which the spores are black, belongs the genus *Coprinus*, which includes some common and important fungi. The species grow mainly on dung, and most of them are small and perishable, but a few attain a considerable size. Pl. XXV represents the horsetail or maned agaric (*Coprinus comatus*), one of the best of our fungi, which appears in the autumn near the close of the season of fungi. It grows in dense but not very numerous clusters among grass and by roadsides, and its stalks extend a considerable distance into the ground. As shown on Pl. XXV, the pileus, instead of expanding, remains in the form of a closed umbrella, and does not roll outward until it begins to decay, when, instead of putrefying in the manner of most fungi, it quickly dissolves, forming a black, inky fluid. The pileus is white and is covered with large, fringy scales, to which it owes its name. The gills are broad, lie close to the stalk, and turn from pink to black. The stalk is not infrequently 8 or 10 inches long, hollow, at first with a fibrous string in the axis, brittle, and has a small ring, which is not attached like those previously described, but hangs loose around the stalk, so that it can be moved up and down. The horsetail is not likely to be mistaken for any poisonous species. While it does not in ordinary seasons appear until autumn, in exceptional cases it appears in small quantities early in the summer, then disappearing to return again in autumn.

Two other very common species of *Coprinus* are found from spring to autumn and form very large and crowded groups, not infrequently containing a hundred specimens, around the bases of trees, posts, and

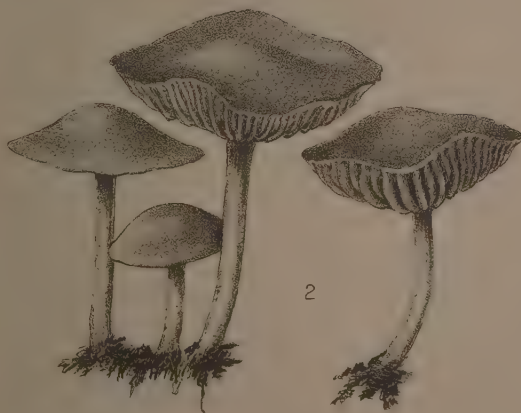
even of masonry. They are decidedly the commonest edible species found near houses in other than thinly settled regions. The larger of the two species, *Coprinus atramentarius*, has a closed pileus, like the horsetail, but its outline is as near conical as oval and the stalk is short and stout. The surface is not white, but an ashy black, and instead of having scales, it is furrowed with irregular longitudinal folds. The other species, *Coprinus micaceous*, is smaller and less fleshy than the two above mentioned, and the pileus is often date-colored or of a shade resembling buff. The surface is marked with regular and fine longitudinal grooves, and usually, but not always, appears to be sprinkled with fine shining particles looking like mica. It should be noticed that the spores of this species are not a pure black, but have a brown tinge, and it does not liquefy so quickly when old as the other two species. In taste these last two species are decidedly inferior to the horsetail, but they possess the advantage of being very common and growing near houses.

LESS COMMON EDIBLE FUNGI.

In the description of species so far referred to, it has been necessary to enter more or less into details, since they should be well known by anyone who attempts to collect fungi. The fungus eater who goes into the woods or fields will be sure to find in most seasons a multitude of toadstools which are quite bewildering. He ought to recognize amongst them some of the species already mentioned, but what can be said of the rest? Those that are very small, very tough, or that have a disagreeable taste may be passed by without further notice; but there still remains a large number of species, some of which are known to experts to be edible and some poisonous, while about others there is no definite knowledge. It is impossible to do more in the space of this paper than to give a hasty glance at certain typical species, with such comments as may help the beginner. So far, all the species mentioned belong to the gill-bearing group, the largest group of the Hymenomycetes, or toadstools. In this group the species may have spores which, roughly classified, are either white, pink or salmon colored, brown, purple, or black. The color of the spores can generally be inferred from the color of the mature gills, but that is not always the case, and the only sure way is to let the spores fall on paper, as already described. The color of the spores in any species is practically constant, whereas the color of the pileus may vary a great deal, as is seen in the fly agaric, which may be either bright yellow or red. The gills vary in the different species. In some they are sharp edged, in others blunt and more like ridges. In some cases the gills do not reach the top of the stalk, while in others they reach the stalk or extend down over it some distance. The stalks are sometimes solid and sometimes hollow, and in some, but not in most species, there is a ring, which may either be fixed like



PARASOL FUNGUS (*LEPIOTA PROCERA*), EDIBLE.



1, CHANTERELLE (*CANTHARELLUS CIBARIUS*), EDIBLE; 2, FAIRY-RING FUNGUS (*MARASMIUS OREADES*), EDIBLE.

a collar or quite free. Comparatively few of our species have a distinct volva or wrapper round the base of the stalk, but it is very important to know whether there is such a wrapper or not, since our most poisonous species have them, and unless one is an expert he should reject any toadstool having white gills and spores and a wrapper round the base of the stalk or a bulbous base clothed with scales.

PARASOL FUNGUS, CHANTERELLE, AND FAIRY-RING FUNGUS.

Among the white-spored species, which are more numerous than the others, may be mentioned the parasol fungus (*Lepiota procera*), represented on Pl. XXVI. It is large and tall and can be seen at some distance standing up in the grass where it grows. It is rather tough and does not decay quickly. Its color is sometimes whitish, but it is often brownish. The pileus is covered with coarse, flocculent scales, and the ring is free and not fastened to the stalk. The parasol fungus is not likely to be mistaken for any poisonous species. The same may be said of the chanterelle (*Cantharellus cibarius*, Pl. XXVII, 1), which is common in moist woods, whether coniferous or deciduous, in July and later. It is always of an egg yellow in all its parts and differs from all the species hitherto mentioned in having a crumpled, irregular margin, and a more or less depressed upper surface, and particularly in having shallow, blunt gills, which are prolonged down over the stalk in wavy ridges.

The fairy-ring fungus (*Marasmius oreades*) is a small species, seldom more than 2 inches broad, which grows in clusters in lawns and pastures, and the clusters form circles or segments of circles, called fairy rings, in the grass. There are, however, many other fungi which form fairy rings, and this almost seems to be the normal method of growth of species which frequent clear, level ground, but the rings are not in many species so distinct as in this case. The substance of the fairy-ring fungus is quite tough, and specimens which appear to be dry and dead revive in rainy weather. Pl. XXVII, 2, shows the fungus in its ordinary condition, and bearing in mind that the gills are comparatively few and bulge out in the middle, that the stalk is tough and tubular, and that the pileus is thin, of a pale yellow-brown or drab color, and often concave on top, with the center raised in a knob, one ought to recognize this species, although it must be admitted it is not always easy for the beginner by a description alone to distinguish it from some of the numerous small species which grow among the grass in cultivated fields. The spores of the fairy-ring fungus, however, are white, while those of the species with which it may be confused are generally brown or blackish. Some of these small species with dark-colored spores are dangerous, and several cases of poisoning, although not fatal, have been known to occur in this country, the small fungi growing in lawns having been gathered indiscriminately and eaten.

FUNGI WITH MILKY JUICE.

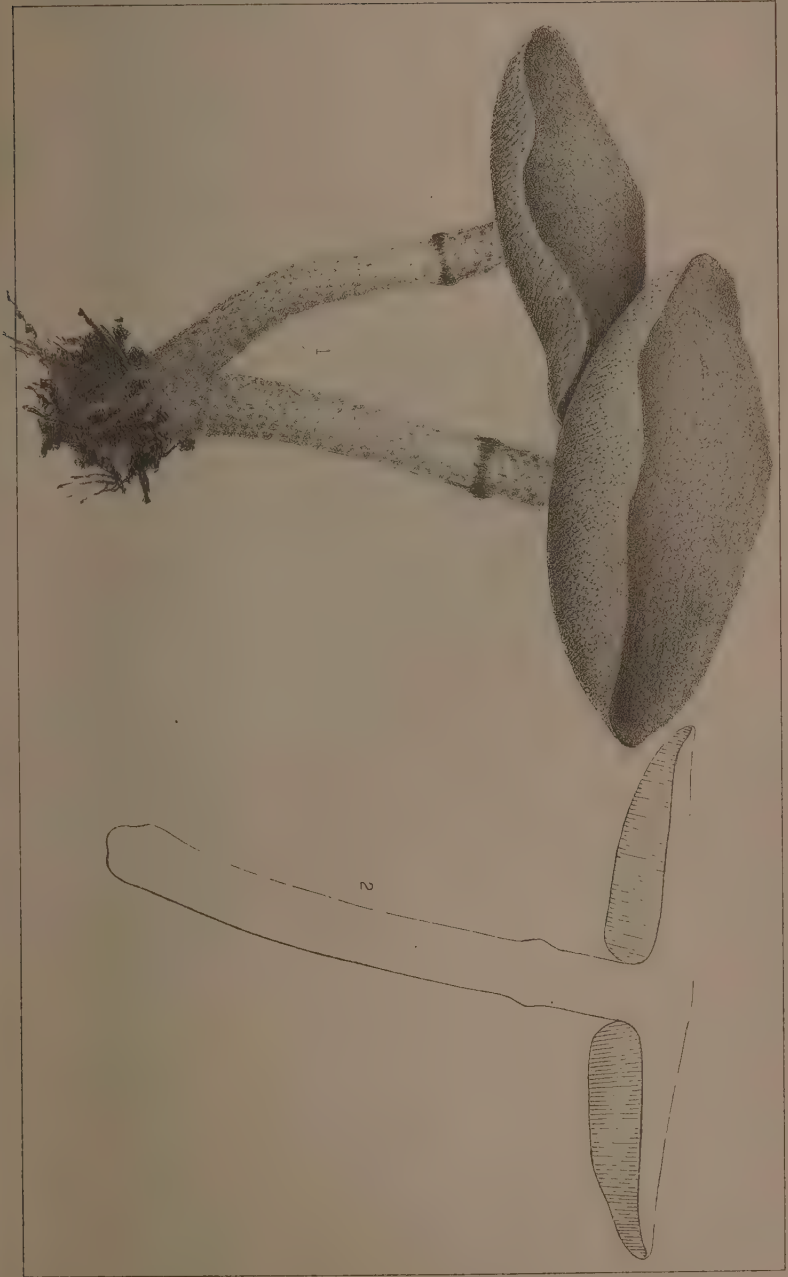
The genus *Lactarius* includes the gill-bearing fungi which, when broken or cut, exude a milky juice. The juice is often very copious, but in some species is scanty. Late in the season, however, the milk is less abundant than in midsummer. The milk is generally white, but it may be reddish or blue; in some cases it is a thin, fluid-like serum, and in others the milk changes color on exposure to the air. The species of *Lactarius* abound in midsummer and early autumn in both dry and swampy woods and also in dry pastures, and some of them are very inviting, being of good size, plump, and firm in substance, and of an agreeable white or brighter color, but unfortunately the milk of many of them is acrid and biting, and in not a few species a single taste is sufficient to satisfy anyone. The acidity is somewhat modified by cooking, but it is hardly worth the trouble for any but the most enthusiastic mycophagist to take much pains for so little good. It is generally safe to eat those species of *Lactarius* which do not have an acrid juice, and among them is a highly esteemed species, *Lactarius deliciosus*, a beautiful fungus, rather common in damp woods in mountainous regions, but not common in the lowlands. It can not be mistaken for any dangerous species, and is at once recognized by its copious milk, which is red, with a shade of orange, and does not change color, except after long exposure, when it becomes slightly greenish. The fungus itself has nearly the same color as the milk which exudes from it, but is a little paler.

SPECIES FOR THE EXPERT ONLY.

Among the prettiest of our fungi, very attractive to the passer-by from the bright red, purple, or yellow pilei, are the species of *Russula*, which are often very abundant in summer in woods and swamps, and, in fact, almost anywhere, especially under or near trees. They are not generally of large size, although some are, and are to be distinguished by having very thin pilei, almost membranous except at the center, and by having the white, pale cream, or buff-colored gills arranged very regularly like the spokes of a wheel, with no shorter gills, or at least very few, inserted between them. Some of the *Russulæ* are acrid like the *Lactarii*, but others have a pleasant taste. The different species of *Russula* are very difficult to distinguish, even by experts, and the beginner would better postpone experiments with this genus until he has first made himself acquainted with less doubtful genera, since some of the *Russulæ* are poisonous.

THE OYSTER FUNGUS.

We shall conclude all that can be said on the gill-bearing fungi by a word on the oyster fungus (*Pleurotus ostreatus*). This belongs to a group which does not have a central stalk, but has the fungus attached laterally by a very short stalk, as a rule, to the trunks of



BOLETUS SUBPLUTEUS, EDIBLE; 1, ENTIRE PLANT; 2, SECTION.

trees. The oyster fungus is so called, not because it tastes like an oyster, but because its habit of growth is to have a number of individuals overlap one another, bearing a somewhat remote resemblance to a heap of oyster shells. These overlapping masses often reach a large size, sometimes several square feet, and are whitish or dirty yellow, with long gills which converge toward one side of each individual pileus. The oyster fungus is generally at its best quite late in the season, being found even in November in the Northern States, and although there are other species which resemble it, they are not dangerous. Its quality is not very good, but some persons like it.

TUBE-BEARING FUNGI.

Of the species so far considered, the mushroom and its immediate allies have brownish-purple spores, the horsetail and its allies black spores, but all the others mentioned have white, or nearly white, spores. The pink-spored species of toadstools are not so numerous as the others and include but few edible forms, and some which are believed to be poisonous. The brown-spored species are decidedly more numerous, but as they include no prominent edible species they can not well be included in the present paper. We may, therefore, pass at once to the next group—fungi having tubes instead of gills.

The Polyporei, or tube-bearing fungi, include a large number of species. Only a part of these would come under the popular name of toadstools, since a great portion do not have a central stalk and pileus, but are, like the oyster fungus, either attached laterally or have no stalk at all, and lie flat on the substratum. As illustrations may be mentioned the large punk fungi, which are used by ladies for making ornamental brackets. Furthermore, the greater part of the species are tough and hard and could not be eaten. With very few exceptions the edible species of Polyporei all belong to the genus *Boletus*, of which the species are soft and fleshy, shaped like toadstools, and, with hardly an exception, grow on the ground in woods and pastures. They are often abundant in midsummer, but less so in autumn. To this genus belong the fungi known in France as *cèpes*, under which name they are imported into this country, but not in any great quantities. The United States has a number of edible species, some peculiar to this country and some the same as the best French species; but unfortunately there are here also a number of poisonous species, and, since the species of the genus are in many cases far from easy to distinguish from descriptions alone, the writer can only refer in general to some of the main features of the species, without going into details which are rather complicated for a first lesson in distinguishing fungi.

Pl. XXVIII, which represents a common species, *Boletus subluteus*, edible, but not one of the best, shows the toadstool-like habit of the genus, but with closely packed tubes on the underside instead of

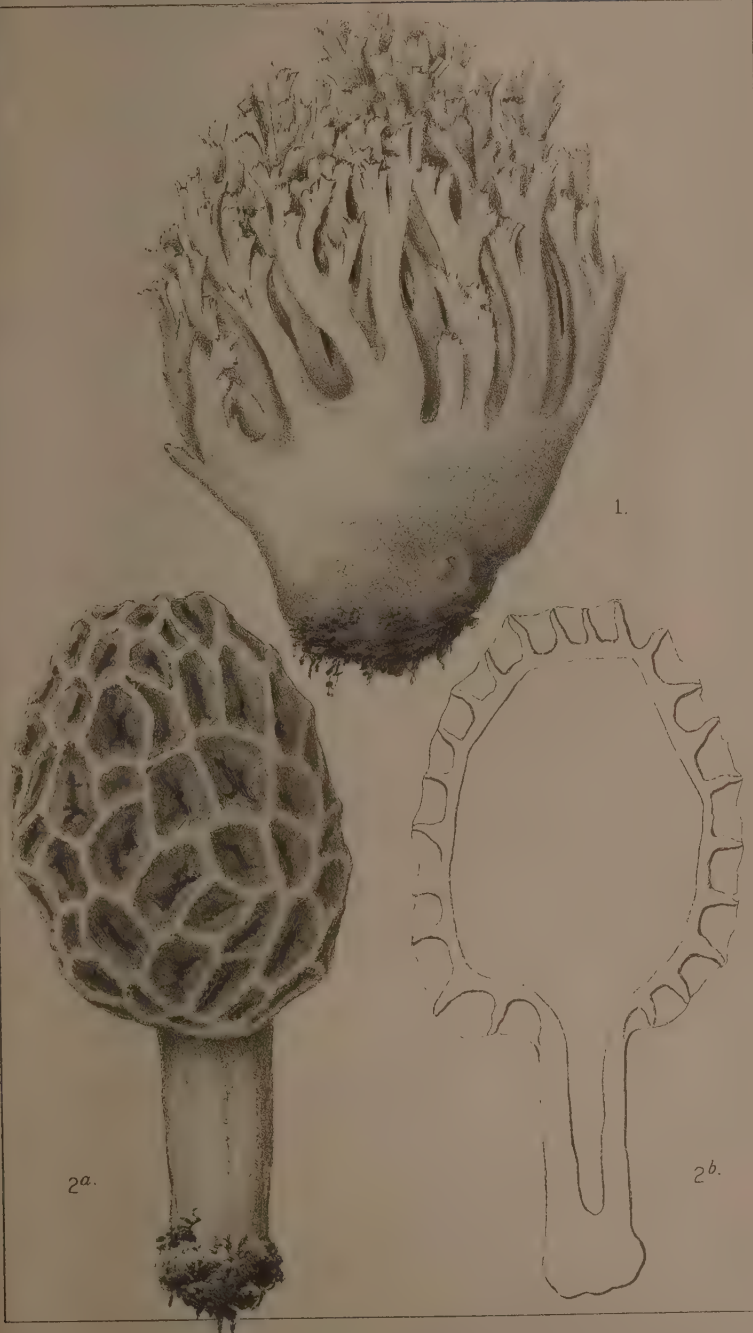
gills. The upper surface of the pileus is viscid when wet, and is of a dark, dingy brown, the tubes being rather lighter colored, and the solid stalk, which has a rather slimy, band-like ring, is gray or slate colored, mottled with brown spots and granulations.

The *cèpe* proper, the *Steinpilz* of the Germans, is much larger, at times nearly a foot broad, with a solid convex pileus, varying from dull white to buff color or even darker, and a stout stalk, variable in length, but usually broader at the base than at the apex and generally with a network of veins over the upper part, but without a ring. The tubes are about an inch long, but become shorter as they approach the stalk and the margin, so that, taken collectively, they form a convex disk. They are at first whitish, but become yellow, and finally a yellow green. This fungus inhabits stony soils in woody or bushy places, and is not so widespread as the species last mentioned, which is found in pastures, by shady roadsides, and on the borders of woods. The *cèpe* is not very easily distinguished from certain other species by a beginner, who should be warned against a species sometimes mistaken for it, which has, however, a bitter taste, not possessed by the *cèpe*.

For the present these two species must serve as types of the edible Boleti. Certain other species are far more striking in appearance, having brilliant blood-red or peach-colored pilei, but they belong to a dangerous group, which has caused serious and probably fatal cases of poisoning. It may be stated briefly that those Boleti in which the mouths of the tubes are red or of a different color from the rest of the tubes should be avoided. The flesh of some of the species when broken or bruised changes color, usually becoming blue, but sometimes red. Such species as show a change of color when broken should also be avoided. In fact, the genus, as a whole, is a dangerous one, not because there is not a considerable number of excellent edible species in it, but because they vary more or less, and it is difficult to draw the line between the edible and the poisonous species. It may be said, however, that even the poisonous Boleti are not so poisonous as some of the *Amanitæ* already mentioned.

THE BEEFSTEAK FUNGUS.

In passing, only one member of the tube-bearing fungi which does not belong to the genus *Boletus* can be referred to. The beefsteak fungus (*Fistulina hepatica*) is quite unmistakable. It grows on stumps, especially of oak or chestnut, from which it projects laterally something like a tongue, whence it is called by the French *langue de bœuf*; it is not common in the North, where it is seldom more than 4 inches long. It is more common and attains a considerably larger size in the South. When young the upper side is velvety and of a beautiful peach color, but later it is somewhat slimy or mucilaginous and a deeper red. The flesh-colored tubes on the underside are very



1. CLAVARIA FLAVA, YOUNG PLANT, EDIBLE. 2. MOREL (MORCHELLA ESCULENTA), EDIBLE:
a, ENTIRE PLANT; b, SECTION.

small, so that they can hardly be distinguished without the aid of a hand lens, and they do not lie in close contact with each other, as in the genus *Boletus*, but are slightly separated, so that seen with the naked eye the under surface looks papillated, like the surface of the tongue. The cut surface is streaked with red, like meat, and when raw there is a slight but agreeable acid taste, which disappears on cooking. Prepared for the table, the resemblance to a beefsteak is remarkable; and, although better than some beefsteaks, it certainly can not be said to be as good as the best.

TEETH-BEARING FUNGI.

The teeth-bearing fungi (*Hydnei*), popularly called hedgehog fungi, are found in woods, both wet and dry, where they grow either on the ground or on logs and trunks. Most of the species are too small and woody to be eaten, but there are a few species which are eaten and liked by some persons, but to others they have a bitter or slightly resinous taste.

Hydnum imbricatum is common in dry woods, especially coniferous woods, and may be recognized by its blackish-brown color, looking at times as if it had been burnt. The upper surface is cracked and split into thick, wedge-like scales and the under surface is thickly covered with ash-colored or bluish-gray teeth, or spines. *Hydnum repandum* prefers damp and wet woods, is much softer and more friable than the last-named species, and is also smaller and slenderer. The color varies from white to brownish and reddish yellow, the teeth being nearly white.

SOME OTHER EDIBLE FORMS.

Of the family of the Thelephorei, in which the spores are borne on a smooth or merely wrinkled surface, most of the species are small, and our larger species are generally tough and leathery so that the family is of little importance as food.

The coral-shaped fungi (*Clavarei*) include a certain number of good-sized species which frequent woods; none of them are poisonous, and several are very palatable. The coral-like habit is shown on Pl. XXIX, 1, and without stopping to describe any particular species, it may be said that it is safe for the beginner to try any of the members of this group, and he will find at least some of them worth trial.

MORELS AND TRUFFLES.

Among the best edible fungi are the morels, which are not only good when fresh, but can be dried, like the fairy-ring fungus. Pl. XXIX, 2a, representing a common morel (*Morchella esculenta*), shows the general habit of the genus, which would easily be recognized from the figure. Botanically considered, the morels are not closely related to the toadstool family, although they have a certain external

resemblance to toadstools, but the botanical distinctions are microscopic rather than gross and need not be described here.

The morels appear toward the end of spring or early in summer in grass under or near trees, even in rather thickly settled regions, but are more abundant in places which have been burned over. They have a peculiar honeycombed upper portion, which is at first cream-colored, but becomes darker yellow. The stalk is whiter, and usually when fresh is covered with fine granulations. In the United States there are several species of morel, differing in the shape of the honeycombed part and in certain microscopic details, but from the figure the genus can be recognized, and all the species are safe. One should, however, glance at the section of a morel shown on Pl. XXIX, 2*b*, and notice that the upper honeycombed part is continued directly into the stalk, and is not, like a cap, attached at the upper part, with the margins free and bending away from the stalk.

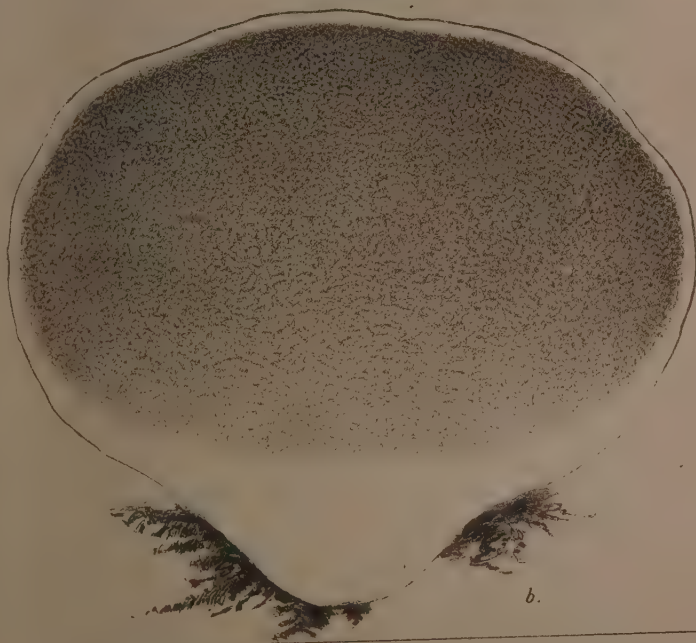
The most expensive and most highly prized of all fungi are the truffles, which grow buried in the soil and in general appearance resemble small potatoes. The best truffles are black and have a warted surface. Some species have a strong odor of garlic; others a peculiar delicate perfume which can not be described. Although in this country we have a few species related botanically to the truffles of Europe, no one has as yet discovered here the valuable species of France and Italy, which are the only truffles found in our markets; but it is not impossible that at some future day the same or equally good specimens may be found in hilly regions where oaks occur on poor calcareous soils.

PUFFBALLS.

By far the greater part of our edible and poisonous fungi belong to the Hymenomycetes, or toadstool family; but there are a few others which must be mentioned briefly. The puffballs, belonging to the family Gasteromycetes, are familiar to almost everyone, and grow usually, but not always, on the ground in lawns, cultivated places, and woods, with a preference for thin and sandy soils, but they are not limited to such localities. With few exceptions, our common native species have no stalk, but lie on the ground or partly buried in the ground, looking like slightly flattened balls. If they are cut in two, as on Pl. XXX, *b*, one sees in their younger condition a homogeneous interior substance surrounded by an external wrapper composed of two distinct layers. The outer layer often bears spines or papillæ, which add much to the beauty of the puffballs. When mature the interior portion, or a part of it, is changed into a mass of yellow-brown or purple powdery spores, with which are entangled numerous hairlike threads. Finally, the outer membrane breaks away in patches, the inner membrane is ruptured irregularly, or occasionally, a regular mouth is formed, and the spores are discharged.



a.



b.

PUFFBALL (*LYCOPERDON CYATHIFORME*), EDIBLE: *a*, ENTIRE PLANT; *b*, SECTION.

The most striking species is the giant puffball (*Lycoperdon giganteum*), which is not rarely 40 inches in circumference. It has a smooth white surface like kid, which becomes brown when old, and when a number of them are seen on the ground at a distance they look like a flock of miniature sheep. The species is not common except in certain localities, as the region of San Francisco Bay, but when a single large specimen is found it furnishes enough food for some days. The flesh is firm and white or pale yellow green when in condition for eating, but when mature the interior becomes a mass of yellowish-olive powder.

Another species, *Lycoperdon cyathiforme*, Pl. XXX, is much more common, growing in lawns and other grassy places, where it forms fairy rings, which sometimes injure the lawns in suburban districts. It is frequently 6 inches in diameter, and differs in shape from the giant puffball in not being a flattened sphere, but broader and flattened at the top and contracted toward the base. It varies from white to brown, and, except when quite young, the outer membrane of the top of the puffball is marked in a tessellated manner. The ripe spores are blackish purple when mature, unlike those of the giant puffball. There are a few other large species, but most of the puffballs so common in pastures are not more than from 1 to 3 inches in diameter.

With possibly one exception, and the records of injury done in this case are not very conclusive, none of the puffballs are poisonous if eaten before the interior becomes crumbly and powdery. The suspected species, *Scleroderma vulgare*, very common around houses and gardens and along roadsides, is 2 or 3 inches in diameter, very tough and hard, with a yellowish-brown, warty exterior, and within is purple black, marbled with white. Its solidity, coarse external warted wall, and the marbled interior, which remains hard and solid until the fungus is quite old, serve to distinguish it from the softer, thinner-walled edible species. It may perhaps be a question whether this species is really dangerous, but at all events it offers few attractions to the fungus eater.

SUMMARY.

In conclusion, it is only necessary to give a summary of the preceding pages in the form of certain rules to guide the collector. Most of the rules have exceptions, which are well known to experts, but the beginner is of course under the necessity of following the rules implicitly, for an imperfect guide is better than none at all.

It is a rule of whist that when one is in doubt he should take the trick, but in the case of fungi the reverse is true. If one has any doubt as to whether a fungus which he has collected is edible or not, he should act on the supposition that it is not edible, or at least that it is under suspicion, and should be experimented upon with great care.

The different popular tests for distinguishing edible from poisonous fungi, such as, for instance, the blackening of a silver coin or spoon when placed in a mass of poisonous fungi while they are being cooked, are all absolutely worthless. There is no test which can be applied, nor should reliance be placed, at least by the beginner, upon the fact that in some cases the poisonous substances may be removed by cooking in milk or vinegar. In such cases the danger may be only increased unless care is taken to remove all the vinegar or milk, and, in general, common sense warns us not to eat any fungus supposed to contain an active poison which requires to be removed by special treatment. The eating of such species should be left to the scientific experimenter. On the other hand, it need not be assumed that a fungus is poisonous when it is merely indigestible in consequence of the way in which it is cooked.

It is beyond the province of this paper to discuss the nature of the poison of different fungi, but it should be said in general that the poisonous effects are of two kinds: The irritant, which affect the stomach and digestive organs directly, and show their effects soon after eating; and the narcotic, much more dangerous, which act upon the nervous centers and do not produce poisonous symptoms until after a number of hours, usually eight or ten. The irritant fungi are often recognizable by their taste when raw, but the narcotic species are generally pleasant to the taste, or at least not disagreeable.

The following rules should not be neglected by the beginner:

(1) Avoid fungi when in the button or unexpanded stage; also those in which the flesh has begun to decay, even if only slightly.

(2) Avoid all fungi which have stalks with a swollen base surrounded by a sac-like or scaly envelope, especially if the gills are white.

(3) Avoid fungi having a milky juice, unless the milk is reddish.

(4) Avoid fungi in which the cap, or pileus, is thin in proportion to the gills, and in which the gills are nearly all of equal length, especially if the pileus is bright colored.

(5) Avoid all tube-bearing fungi in which the flesh changes color when cut or broken or where the mouths of the tubes are reddish, and in the case of other tube-bearing fungi experiment with caution.

(6) Fungi which have a sort of spider web or flocculent ring round the upper part of the stalk should in general be avoided.

Rules 1, 2, and 5 may for the beginner be regarded as absolute, with the exception to rule 2, *Amanita caesarea* (p. 458), the gills of which are yellow. Rules 3, 4, and 6 have more numerous exceptions, but these rules should be followed in all cases unless the collector is content to experiment first with very small quantities and learn the practical result.

